
APPENDIX A
HOT MIX ASPHALT (HMA) DESIGN CRITERIA

OVERVIEW OF THE HMA MIXTURE DESIGN CRITERIA CHART

The HMA Mixture Criteria chart identifies the aggregate, mixture volumetric, and laboratory density requirements for mixtures designed under the gyratory mix design system. The chart is formatted to correspond with the bid item designations. The bid item designations classify each mixture by the maximum 20-year traffic load (ESAL), the intended pavement layer (surface, intermediate, base), the mixture size (based on nominal maximum aggregate size), and the surface layer friction requirement. A designation of **"HMA 3M S 1/2 L-3"** describes the HMA mixture for up to 3 million ESALs, surface layer, 1/2 inch mixture size, with level 3 friction aggregate.

The columns to the right of the mixture designations define the required level of compaction (N values) and the maximum or target density (expressed as percent of G_{mm}) associated with each level of compaction. Note that the required density of a given level of compaction varies for different traffic levels and pavement layers. For example, the 1M ESAL surface/intermediate 7-76-117 mixture requires 96 percent of G_{mm} (4.0% air voids) at N-design. The 7-76-117 base mixture for 3M ESALs requires 96.5 percent of G_{mm} (3.5% air voids) at N-design.

The middle columns identify the volumetric properties of the compacted HMA mixture when analyzed at the target air voids at N-design.

The aggregate properties are defined in the right columns. The quality of the aggregate (Type A or B) is further specified in Standard Specifications 4126 and 4127. The crush value specifies the minimum amount of crushed aggregate required. The Fine Aggregate Angularity and Sand Equivalent values are consensus properties of the fine aggregate portion of the mix. The friction columns specify the minimum amounts of friction quality coarse aggregate (Type 4, 3, 2) as defined in Materials IM T203. The details of the friction criteria are specified in Standard Specification 2303. Table Note 4 defines the allowable quantity of flat and elongated aggregate for all mixtures.

For any specified HMA mixture, the mix design criteria are found by reading across the table. The HMA mixtures are grouped by ESAL levels.

HMA MIXTURE DESIGN CRITERIA

| Mix Designation | Gyratory Density | | | | Mix Volumetrics | | | | Friction ⁽²⁾ | | | Aggregate ⁽⁴⁾ | | | | | | |
|------------------------------|--|---------------------------------------|---|---------------------------------------|-----------------|-------|-------------------|-------------------|-------------------------|-----------------|------------------|--------------------------|-------------------|--------------|------------------------|----|--|--|
| | N _{ini} - N _{des} - N _{max} | Initial % G _{mm} (max) | Design % G _{mm} (target) | Maximum % G _{mm} (max) | VMA (min) | VFA | Film Thickness | Filler: Binder | Type 4 (min) | Type 3 (min) | Type 2 (min) | Quality Type | Crush (min) | FAA (min) | Sand Equiv (min) | | | |
| HMA 100K S-I-B 3/8 | 7 - 68 - 104 | 92.5 | 97.0 | 98.5 | 15 | 75-85 | 8-13 | 0.6-1.4 | | | | B ⁽¹⁾ | 45 ⁽¹⁾ | --- | 40 | | | |
| HMA 100K S-I-B 1/2 | | | | | 14 | | | | | | | | | | | | | |
| HMA 300K S-I 3/8 | 7 - 68 - 104 | 92.0 | 96.5 | 98.0 | 15 | 70-80 | 8-13 | 0.6-1.4 | | | | B ⁽¹⁾ | 45 ⁽¹⁾ | --- | 40 | | | |
| HMA 300K S-I 1/2 | | | | | 14 | | | | | | | | | | | | | |
| HMA 300K B 1/2 | 7 - 68 - 104 | 92.5 | 97.0 | 98.5 | 14 | 75-85 | | | | | | B ⁽¹⁾ | 45 ⁽¹⁾ | --- | 40 | | | |
| HMA 300K B 3/4 | | | | | 13 | | | | | | | | | | | | | |
| HMA 1M S 3/8 L-4 | 7 - 76 - 117 | 90.5 | 96.0 | 98.0 | 15 | 65-78 | 8-15 | 0.6-1.4 | 50 | | | A ⁽¹⁾ | 60 ⁽¹⁾ | 40 | 40 | | | |
| HMA 1M S 1/2 L-4 | | | | | 14 | | | | 50 | | | | | | | | | |
| HMA 1M S 3/8 | | | | | 15 | | | | | | | | | | | | | |
| HMA 1M S 1/2 | | | | | 14 | | | | | | | B ⁽¹⁾ | 45 ⁽¹⁾ | | | | | |
| HMA 1M I 1/2 | | | | | 14 | | | | | | | | | | | | | |
| HMA 1M I 3/4 | | | | | 13 | | | | | | | | | | | | | |
| HMA 1M B 1/2 (incl pav shld) | 7 - 68 - 104 | 92.0 | 96.5 ⁽³⁾ | 98.0 | 14 | 70-80 | | | | | B ⁽¹⁾ | 45 ⁽¹⁾ | --- | | | | | |
| HMA 1M B 3/4 (incl pav shld) | | | | | 13 | | | | | | | | | | | | | |
| HMA 3M S 1/2 L-4 | 7 - 86 - 134 | 89.5 | 96.0 | 98.0 | 14 | 65-78 | 8-15 | 0.6-1.4 | 50 | | | A | 75 | 40 | 40 | | | |
| HMA 3M S 1/2 L-3 | | | | | 14 | | | | 80 | 45 | (30) | | | | | | | |
| HMA 3M S 1/2 | | | | | 14 | | | | | | | | | | | | | |
| HMA 3M S 3/4 | | | | | 13 | | | | | | | B | 45 | | | | | |
| HMA 3M I 1/2 | | | | | 14 | | | | | | | | | | | | | |
| HMA 3M I 3/4 | | | | | 13 | | | | | | | | | | | | | |
| HMA 3M B 3/4 | 7 - 76 - 117 | 90.5 | 96.5 | 98.0 | 13 | 65-78 | | | | | | | | | | | | |
| HMA 10M S 1/2 L-3 | 8 - 96 - 152 | 89.0 | 96.0 | 98.0 | 14 | 65-78 | 8-15 | 0.6-1.4 | 80 | 45 | (30) | A | 75 | 43 | 45 | | | |
| HMA 10M S 3/4 L-3 | | | | | 13 | | | | 80 | 45 | (30) | | | | | | | |
| HMA 10M I 1/2 | | | | | 14 | | | | | | | | | | | | | |
| HMA 10M I 3/4 | | | | | 13 | | | | | | | B | 75 | | | 40 | | |
| HMA 10M B 3/4 | 7 - 86 - 134 | 89.5 | 96.0 | 98.0 | 13 | 65-78 | | | | | | | | | | | | |
| HMA 10M B 1 | | | | | 12 | | | | | | | | | | | | | |
| HMA 30M S 1/2 L-3 | 8 - 109 - 174 | 89.0 | 96.0 | 98.0 | 13.5 | 65-75 | 8-15 | 0.6-1.4 | 80 | 45 | (30) | A | 85 | 45 | 45 | | | |
| HMA 30M S 1/2 L-2 | | | | | 13.5 | | | | 80 | | 25 | | | | | | | |
| HMA 30M S 3/4 L-3 | | | | | 12.5 | | | | 80 | 45 | (30) | | | | | | | |
| HMA 30M S 3/4 L-2 | | | | | 12.5 | | | | 80 | | 25 | B | 75 | | | 40 | | |
| HMA 30M I 1/2 | | | | | 13.5 | | | | | | | | | | | | | |
| HMA 30M I 3/4 | | | | | 12.5 | | | | | | | | | | | | | |
| HMA 30M B 1 | 8 - 96 - 152 | 89.0 | 96.0 | 98.0 | 11.5 | 65-75 | | | | | | B | 75 | 40 | | | | |
| HMA 100M S 3/4 L-2 | 9 - 126 - 204 | 89.0 | 96.0 | 98.0 | 12.5 | 65-75 | 8-15 | 0.6-1.4 | 80 | | 25 | A | 85 | 45 | 50 | | | |
| HMA 100M I 3/4 | | | | | 12.5 | | | | | | | | | | | | | |
| HMA 100M B 1 | 8 - 109 - 174 | 89.0 | 96.0 | 98.0 | 11.5 | 65-75 | | | | | | | B | 75 | | 43 | | |

Note (1) On local agency projects, the Engineer will specify these values in the plan mix design note.

Note (2) (Friction Note L-4 = 50% Type 4, Note L-3 = 45% Type 3 (opt 30% Type 2) + 80% Type 4, Note L-2 = 25% Type 2 + 80% Type 4) See Standard Specification 2303

Note (3) G_{mm} = 97.0 for shoulders placed separately

Note (4) Flat & Elongated 10% maximum at a 5:1 ratio.

GRADATION REQUIREMENTS

The individual aggregate gradation requirements for HMA mix designs are contained on Form #955.

The combined aggregate shall meet the following gradation requirements:

| Aggregate Gradation Control Points | | | | | | | | |
|---|--|-------------|-----------------------------|-------------|-------------------------------|-------------|------------------------------|-------------|
| Sieve Size | Mix Size - Control Points (% passing) | | | | | | | |
| | 1 inch (25 mm) | | 3/4 inch (19 mm) | | 1/2 inch (12.5 mm) | | 3/8 inch (9.5 mm) | |
| | min. | max. | min. | max. | min. | max. | min. | max. |
| 1 1/2 inch (37.5 mm) | 100 | | | | | | | |
| 1 inch (25 mm) | 90 | 100 | 100 | | | | | |
| 3/4 inch (19 mm) | | 90 | 90 | 100 | 100 | | | |
| 1/2 inch (12.5 mm) | | | | 90 | 90 | 100 | 100 | |
| 3/8 inch (9.5 mm) | | | | | | 90 | 90 | 100 |
| No. 4 (4.75 mm) | | | | | | | | 90 |
| No. 8 (2.36 mm) | 19 | 45 | 23 | 49 | 28 | 58 | 32 | 67 |
| No. 200 (75 µm) | 1 | 7 | 2 | 8 | 2 | 10 | 2 | 10 |

The combined gradations for surface and intermediate mixtures on projects with greater than 10,000,000 design (20 year) ESALs shall be designed with an added gradation control point of 28% maximum passing the No. 16 (1.18 mm) sieve for a 3/4 inch (19 mm) mix size and 32% for 1/2 inch (12.5 mm) mix size. For surface and intermediate mixtures on projects between 3,000,000 and 10,000,000 ESALs, the combined gradation shall be designed with an added gradation control point of 24% maximum passing the No. 30 (600 µm) sieve for a 3/4 inch (19 mm) mix size and 25% for 1/2 inch (12.5 mm) mix size.